



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) Publication number: 0 286 614 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification :
18.12.91 Bulletin 91/51

(51) Int. Cl.⁵ : H04B 7/26, H04Q 7/02,
H04J 3/06

(21) Application number : 88850108.7

(22) Date of filing : 30.03.88

(54) Method and equipment for synchronizing and transmitting information in a radio communication network.

(30) Priority : 03.04.87 SE 8701414

(73) Proprietor : TELEFONAKTIEBOLAGET L M
ERICSSON
S-126 25 Stockholm (SE)

(43) Date of publication of application :
12.10.88 Bulletin 88/41

(72) Inventor : Persson, Bengt Yngve
Box 42
S-182 51 Djursholm (SE)

(45) Publication of the grant of the patent :
18.12.91 Bulletin 91/51

(64) Designated Contracting States :
DE FR GB IT NL

(56) References cited :
EP-A- 0 037 519
DE-B- 2 659 635
TELCOM REPORT, Vol 8, no 2, 1985, pages
85-90, Berlin, DE; K KAMMERLANDER:
"Eigenschaften des zellulären Mobilfunksys-
tems C 450/900"

EP 0 286 614 B1

Note : Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid (Art. 99(1) European patent convention).

Description**TECHNICAL FIELD**

The present invention relates to a radio communication network comprising fixed radio base stations and movable mobile stations and a plurality of radio traffic channels, the base stations being arranged in a cellular system in the radio communication network, and share a radio control channel in time multiplex depending on the cellular system, such that each base station disposes a frame with time slots within a super frame on the control channel. More specifically, the invention relates to a method and equipment for synchronizing and transmitting information in such a radio communication network.

BACKGROUND ART

Telecommunication networks in which information is transmitted on a plurality of radio channels between base stations and mobile stations have been well known for several years. In such networks it is well known to organize the base stations in a cellular system for effectively utilizing available frequency bands. Among radio communication networks with large general coverage may be mentioned the Nordic mobile telephone systems, in which speech transmission on the radio channels between base stations and mobile stations takes place analogously. Several mobile telephone systems with digital transmission of speech on the radio channels between base stations and mobile stations have also been proposed.

It is taught by K. Kammerlander, H.J.v.d. Neyen "Aufgaben und Strukturen der Funkfeststation im Netz C der DBP and P. Donat, G. Merward, W. Riedel "Netzsynchronität und Verbindungsumschaltung im Netz C der DBP, both in the NTG-Fachberichte Bewegliche Funkdienste, Band 90, to have a special organizational radio channel in telecommunication networks for call and control signals between base stations and mobile stations. The base stations in the cellular system share in groups in time multiplex an organizational radio channel so that each base station disposes a time slot within a frame on the organizational radio channel. In its time slot each base station transmits call and control signals on the organizational radio channel to mobile stations at predetermined times in relation to an internal time reference in the base station. The base stations can transmit information simultaneously on one or more radio traffic channels to one or more mobile stations.

For network synchronization, a base station closes down its transmitters for the radio traffic channels during about 75 ms about every tenth minute and receives call and control signals sent from one or more other base stations in their frames on the organizational radio channels. The temporary shut down

takes place to reduce noise on the reception of the call and control signals. In speech transmission the temporary shut down is noticeable as a click every tenth minute, which can be regarded as acceptable. Any time difference between the internal time reference of a base station and the internal time reference of at least one other base station is determined with the aid of a correlator and the received call and control signals from other base stations. Eventual time differences between the time references are utilized for changing the time references so that the time differences decrease.

DISCLOSURE OF THE INVENTION

For several known reasons it is desirable to synchronize base stations in a telecommunication network in which information is transmitted on a plurality of radio traffic channels between base stations and mobile stations. It is particularly desirable here that the synchronization does not require extra transmitters and extra radio channels. It is further a desire to be able to transmit information which is more sensitive than speech to intermittent interruptions in the transmission to and from mobile stations in a radio communication network. A particular desire in such a case is that the transmission of information between the base station and mobile stations shall effectively utilize available radio channels and transmission capacity. In radio communication networks of the kind in question it has so far been a problem to simultaneously satisfy these desires. The invention has the object of solving this problem.

One object of the present invention is to create a method and equipment in radio communication networks with base stations and mobile stations which will enable synchronization of the base stations without this causing unacceptable interruptions in transmitting interruption-sensitive information between base stations and mobile stations.

Another object of the present invention is to create a method and equipment in radio communication networks with base stations and mobile stations which will enable synchronization of the base stations without requiring any extra transmitters or without sending any extra synchronization signals from existing transmitters in the base stations.

A still further object of the present invention is to create a method and equipment in radio communication networks with base stations and mobile stations which will enable synchronization of the base stations and transmission of information such that available radio channels and transmission capacity is utilized effectively.

What is distinguishing for a method and equipment in accordance with the present invention, and preferred embodiments thereof, is disclosed in the independent claims 1 and 5 and the dependent claims

2-4 and 6-8.

Summarily and somewhat simplified, it can be said that in a method in accordance with the invention the transmission of information between base stations and mobile stations takes place in time multiplex on the radio traffic channels, the mobile stations being each allocated a time slot on a radio traffic channel. Analogue information which is to be transmitted on such a channel is digitalized before transmission. In addition, the information which is to be transmitted on a radio traffic channel between a base station and a mobile station is encoded before transmission, using an error-correcting code which extends over two or more time slots of the mobile stations on the radio traffic channel. If the transmission on the radio traffic channels from a base station interferes to a too great extent with reception at this base station of call and control signals from other base stations, the transmission on the radio traffic channels from this base station is interrupted intermittently during a time which is at least as long as a time slot and at most as long as a frame on a radio traffic channel.

If there are time slots at a base station when no information is to be transmitted on any radio traffic channel, the reception at this base station of call and control signals from other base stations preferably takes place during these time slots. Call and control signals received at this base station during these time slots may be primarily used for determining time differences at this base station.

At a base station, the affected mobile stations are preferably allocated time slots on the radio traffic channels as far as possible such that no information will be transmitted on any such channel from the base station in certain time slots.

Any interruption in the transmission on the radio traffic channels from a base station preferably takes place in at most one of the frames in a super frame on the radio control channel.

In summary and somewhat simplified, it may be said that the equipment in accordance with the invention includes time multiplex means at the base stations for transmitting information between base stations and mobile stations in time multiplex on the radio traffic channels, during transmission, these means being adapted to allocate each of the mobile stations at a time slot in a succession of frames on a radio traffic channel. The equipment also includes digitalizing means for digitalizing analogue information which is to be transmitted on the channels. Furthermore, the equipment includes encoding means at the base stations and mobile stations for encoding information which is to be transmitted on a radio traffic channel between a base station and a mobile station using an error-correcting code which covers time slots in two or more successive frames on the radio traffic channel of the mobile station. Furthermore, the equipment includes transmission interrup-

tion means at the base stations for briefly interrupting transmission from a base station on the radio traffic channels if the transmission on them interferes too greatly with the reception at the base station of call and control signals from other base stations. The transmission interruption means are adapted to interrupt the transmission, where appropriate, during a time which is at least equally as long as a time slot and at most equally as long as a frame on a radio traffic channel.

The reception means are preferably adapted such as to receive call and control signals at a certain base station from other base stations during time slots when no information is to be transmitted on any radio traffic channel from that base station, should such time slots be present. In such a case the time difference measurement means are preferably adapted such as to primarily use call and control signals received at that base station during these time slots for determining any time differences.

The time multiplex means at a base station are preferably adapted such as to allocate to the mobile stations time slots on the radio traffic channels as far as possible such that no information will be transmitted on any such channel from the base station in one or more certain time slots.

The transmission interruption means are preferably adapted such as to interrupt the transmission, in appropriate cases, on the radio traffic channels from a base station during at most one of the frames in a super frame on the radio control channel.

A method and equipment in accordance with the invention brings with it several advantages, which are accentuated in the preferred embodiments. Heavily simplified, these advantages can be said to signify that no particular transmitter or synchronizing signals are needed for the synchronization, that the need of interrupting the transmission from base stations on the radio traffic channels due to a synchronization is reduced or eliminated, and that the damaging effects of possible interruption in the transmission from the mobile stations due to synchronization is reduced or eliminated. In addition, effective utilization of available radio channels is enabled. Further advantages will be understood by one skilled in the art after studying the following description of preferred embodiments.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 illustrates, heavily simplified, some base stations and mobile stations in a radio communication network.

Figure 2 illustrates the distribution of time slots on radio traffic channels.

Figure 3 illustrates the distribution of frames and time slots within a super frame on a radio control channel.

Figure 4 is a simplified block diagram of parts of a mobile station.

Figure 5 is a simplified block diagram of parts of a base station.

BEST MODES FOR CARRYING OUT THE INVENTION

Base stations BS1, BS2,... and mobile stations MS1, MS2,... in a radio communication network are illustrated heavily simplified in Figure 1. In addition to the illustrated base stations and mobile stations there may be a large number of further stations in the radio communication network. Furthermore there are mobile switching centres in the fixed part of the telecommunication network, which are adapted for transmitting information in the fixed part of the network between base stations. The base stations are conventionally arranged in a cellular system according to a nine-cell plane.

For transmitting information between base stations and mobile stations there is a total of 80 duplex-type radio traffic channels. Of these, a base station normally only disposes over a lesser number, and different base stations can dispose over different numbers of such channels. Different base stations can also dispose completely or partially over different channels, depending on how they are arranged in the cellular system. Base stations which are at a sufficiently great distance from each other can dispose over the same radio traffic channels.

Transmission takes place in time multiplex on all of the radio traffic channels so that each mobile station is allocated a time slot on a channel. In Figure 2 it is illustrated how the time slots TS0, TS1, TS2, TS3, TS4 on the channel CH1 in a direction from a base station are allocated to the mobile stations MS1, MS2, MS3, MS4 and MS10. The time slots TS5, TS6 and TS7 on the channel CH1 in a direction from the base station have not been allocated to any mobile station and are unoccupied. On the channel CH2 the time slots TS1, TS2, TS3, TS4 and TS5 in a direction from the base station have been allocated the mobile stations MS9, MS12, MS8, MS14 and MS11. The time slots TS0, TS6 and TS7 on the channel CH2 in a direction from the base station have not been allocated to any mobile station and are unoccupied. If a base station only disposes over the channels CH1 and CH2 for a distribution of time slots according to Figure 2, it has no information to transmit on any radio traffic channel during the time slots TS6 and TS7.

There is a special duplex-type radio control channel in the radio communication network for call and control signals. Transmission also takes place in time multiplex on the radio control channel. Dependent on its place in the cellular system, each base station is allocated a frame with time slots within a super frame on the radio control channel. In Figure 3 it is illustrated

how frames are allocated on such a channel, i.e. the base station BS1 is allocated the frame F1 with eight time slots TS0, TS1... TS7, base station BS2 the frame F2 with eight time slots TS0, TS1... TS7, base station BS3 the frame F3 with eight time slots TS0, TS1... TS7 etc. The time slots and frames on the radio control channel have the same length as the time slots and frames on a radio traffic channel.

According to Figure 3, each of the nine base sta-

- 10 tions disposes over its own frame on the radio control channel, within a super frame comprising nine frames. That precisely nine frame are included in a super frame on the radio control channel is due to the base stations being conventionally arranged in a cellular system according to a nine-cell plane. At a sufficient distance from one of the base stations, e.g. BS5, the cellular system of the radio communication network may have one or more base station also disposing over frame F5 on the radio control channel.
- 15 Similarly, at a sufficiently great distance from another of the base stations, e.g. base station BS2, there may be one or more base stations which also dispose over frame F2 on the radio control channel. The same applies for remaining frames within the super frames
- 20 on the radio control channels.
- 25

Each base station transmits in its frame call and control signals on the radio control channel to served mobile stations at predetermined times in relation to an internal time reference in the base station. Since each frame on the radio control channel includes eight time slots, a base station can transmit eight call and control signals in each super frame, these signals can partly relate to general information to all mobile stations within the area for the base station, and partly to selective information to individual mobile stations. The control signals from the base station on the radio control channel may, for example, relate to time slot distribution and other signalling to the concerned mobile stations after access.

- 30
 - 35
 - 40
 - 45
- Since the radio control channel is a duplex channel like the radio traffic channels, the mobile stations can communicate with a base station on the control channel, e.g. for calling up. The mobile stations can also use the call and control signals transmitted from the base stations on the control channel for comparing the signal strength of different base stations.

- 50
 - 55
- A simplified block diagram of a mobile station in a radio communication network of the kind described in conjunction with figures 1-3 is illustrated in Figure 4. This mobile station is intended for both speech and data transmission. It includes a microphone 10 coupled to a speech encoder 11, which digitalizes speech information from the microphone. Via first switching means 12 the speech encoder 11 is connected to a channel encoder 13. The channel encoder is connected to a radio transmitter 14. The transmitter is connected to an antenna 15.

A radio receiver 24 is connected to an antenna

25, which may be the same one as the antenna 15. The receiver is connected to a channel decoder 23, which is connected to a speech decoder 21 via a second switching means 22. The speech decoder 21 is connected to a sound reproduction means 20 and decodes digital information into analogue sound information.

A control unit 17 has a first data input connected to data input means 18 and a first data output connected to the first switching means 12. The unit 17 further has a second data input connected to the second switching means 22, and a second data output connected to a data output means 19. In addition, the control unit has control outputs connected to the radio transmitter and receiver as well as the switching means.

In transmitting speech from a mobile station to a base station, the speech is digitalized in the speech encoder 11 before transmission. The digital signals representing speech are taken via the first switch to the channel encoder 13, where they are coded for transmission on a radio traffic channel, using an error-correcting code extending over three or more successive time slots allocated to the mobile station on the radio traffic channel. The transmitter time compresses the digital signals and transmits them at high speed during a time slot under the control of control signals from the control unit.

In transmission of data from the mobile station to a base station, data is supplied to the control unit 17 by the data input means 18. Digital signals representing supplied data are taken from the control unit via the first switching means 12 to the channel encoder 13, where they are coded in the same way as digital signals from the speech encoder. The digital signals from the control unit are subsequently transmitted via the transmitter in the same way as speech.

In transmitting speech from a base station to a mobile station on a radio traffic channel, digital signals are received in the receiver at high speed in a time slot under the control of signals from the control unit 17. The digital signals are expanded in time and taken from the receiver 24 to the channel decoder 23, where error-correcting decoding takes place, which is in principle an inversion of the encoding which took place in the channel encoder 13. The digital signals from the channel decoder are supplied to the speech decoder 21 via the second switching means 22. The digital information from the switching means is decoded in the speech decoder to analogue sound information.

In transmitting data from a base station to a mobile station, the digital signals from the channel decoder are supplied via the second switching means 22 to the control unit 17 instead of to the speech decoder 21. Data from the control unit are supplied to the data output means 19.

Via its control outputs the control unit 17 can con-

trol the transmitter 14 and receiver 24, *inter alia*, for selection of radio traffic channel and time slot. In addition, the control unit can actuate the switching means via its control outputs so that the means transmit and receive either speech information or data.

A simplified block diagram of a base station in a radio communication network of the kind described in connection with figures 1-3 is illustrated in Figure 5. The base station includes a first radio transmitter 31 for the radio control channel, a first radio receiver 32 for the radio control channel, two second radio transmitters 33A and 33B for a radio traffic channel each, and two second radio receivers 34A and 34B for a radio traffic channel each. The receivers and transmitters are connected to antennas via duplex filters and possibly also combiners not illustrated in the figure. The first transmitter is connected to a data transmission means 35 for receiving call and control information which is to be sent from the base station on the radio control channel. Each second transmitter is connected to an output of a multiplexing and demultiplexing means 36 for receiving information which is to be transmitted to the mobile stations on the radio traffic channels. The first receiver is coupled to an input of a receiver synchronizing means 37 for transmitting call and control information received from other base stations on the radio control channel. The receiver synchronizing means 37 has outputs connected to a time difference measurement means 38 and a time slot identification means 39. The time difference measurement means and the time slot identification means have outputs connected to inputs of a regulation means 40. The regulation means has a control output connected to a control input of a clock means 41 and another output connected to an input of a timing means 42. The clock means 41 has an output for clock signals, connected to an input of the timing means 42, which has an output for super frame synchronization signals connected to an input of the time difference measurement means 38. In addition, the timing means 42 has control outputs connected to control inputs of the data transmission means 35, the first transmitter 31, the second transmitters 33A and 33B as well as the multiplexing and demultiplexing means 36. The latter has outputs connected to channel decoders 43, 44 and inputs connected to channel encoders 45 and 46. The channel decoders have outputs and the channel encoders inputs which, via digital links, not illustrated in Figure 4, are connected to a digital mobile switching center in the communication network.

In transmission on the radio traffic channels of information from the switching center via the base station to mobile stations, information from the switching center is transmitted via the digital links to the channel encoders 45 and 46. Information is coded in the channel encoders before transmission, using an error-correcting code extending over time slots in three or more

frames on a radio traffic channel. In the multiplexing and demultiplexing means 36 the coded information is distributed to slots in the radio traffic channels. This distribution is not always the same, and may vary depending on which mobile stations are within the transmission and receiving range or cell of the base station. The information which is to be transmitted to the second radio transmitter is supplied from the multiplexing and demultiplexing means.

In transmission of information from mobile stations to base stations on the radio traffic channels, received information is transmitted from the second receivers 34 A and 34 B to the multiplexing and demultiplexing means 36. Information from the second receivers is distributed by the multiplexing and demultiplexing means to the channel decoders. An error-correcting decoding of received information takes place in the channel decoders such that it is in principle the inverse of the error-correcting coding in the channel encoders. The decoded information from the channel decoders is transmitted via the digital links to the digital switching center.

The time reference of the base station is synchronized with the time references of other base stations with the aid of call and control signals on the radio control channel. Since the base station only disposes over one frame in a super frame on the radio control channel for transmission, call and control signals from other base stations can be received during the other frames in the super frames. Since each base station transmits call and control signals in the time slots in its frame, on the radio control channel at predetermined times in relation to its internal time reference, the time for receiving call and control signals from other base stations gives information as to the internal time references of these base stations. The time difference measurement means measures the time position for received call and control signals in relation to the super frame synchronization signal from the time control means. Information as to the time position is transmitted to the regulation means. With the aid of identification information in the received call and control signals, giving the identity of the transmitting base station and its time slot within the super frame, the time slot identification means can send information to the regulation means as to the identity of the transmitting base station, and what time position the received call and control signals can be expected to have, taking radio propagation time into account, if the internal time reference of the transmitting base station agrees with the internal time reference of the receiving base station. With the aid of the measured time position from the time difference measurement means and the expected time position from the time slot identification means, the regulation means can determine a possible time difference between the local internal time reference in the base station and the internal time reference of the transmitting

base station. In response to this time difference, and preferably corresponding time differences in relation to further base stations, the call and control signals of which have been received on the radio control channel, the regulation means generates a control signal which is supplied to the clock means. The clock means is sensitive to the control signal from the regulation means such that the time position for the clock signals to the time control means is responsive to the control signals.

The super frame synchronization signal, which can be regarded as the internal time reference of the base station, has in turn a time position responsive to the clock signals from the clock means.

The time positions for signals from the time control means to the transmitters as well as the multiplexing and demultiplexing means have in turn a time position responsive to the super frame synchronization signal and clock signals.

If call and control signals from other base station on the radio control channel come to a base station simultaneously as the base station transmits on one or more of the traffic channels, there is a risk that the local transmission of the base station interferes too greatly with the reception. Inter alia, this is because the duplex filter does not give any protection to signals on the radio control channel which are sent from other base stations and are in the same duplex band as the transmission frequencies of the radio traffic signals. For solving this problem, each second transmitter includes transmitter interruption means arranged, on command from the timing means to briefly interrupt the base station transmission on all the radio traffic channels for a time which is at least equally as long as a time slot and at most equally as long as a frame on a radio traffic channel. However, if there are time slots at the base station when no information is to be sent on any radio traffic channel from the base station, then reception of call and control signals from other base stations takes place during these time slots. The need of interrupting the base station transmission on the radio traffic channels is thus reduced or eliminated.

In order to avoid, if possible, interrupting the transmission on the radio traffic channels, the mobile station with which the base station communicates are as far as possible allocated time slots on the radio traffic channels such that no information will be sent on any such channel from the base station in certain time slots, e.g. according to Figure 2.

If, in spite of everything, the transmission on the radio traffic channels must be interrupted, the transmission is interrupted during at most one of the frames in a single super frame on the radio control channel. The interruption in transmission between a base station and a particular mobile station is then limited to one time slot within a super frame. Due to the error-correcting encoding in the channel encoders and the decoding in the channel decoders, as well as that the

encoding includes a slot in three or more successive frames for a mobile station, the transmission can take place without interruption in most cases. Alternatively, more than one transmission interruption may occur in a single super frame in which case the interruptions take place so that no time slot is interrupted more than once or possibly twice in the same super frame.

With the aid of the information as to the identity of the transmitting base stations supplied by the time slot identification means, the regulation means can discover whether acceptable call and control signals are not received from another base station, the internal time reference of which is needed for the synchronization of the base station during a longer time than what can be accepted with regard to the frequency accuracy of the clock means, e.g. 30 seconds. The regulation means is connected directly to the timing means for sending interruption signals demanding transmission interruption. The interruption signals cause, via the timing means, that the transmission from the second transmitter is briefly interrupted. Each interruption has then a duration of at least one time slot and at most one frame.

Primarily base stations, but possibly also mobile stations in a telecommunication network can naturally contain a number of means and functions which are not illustrated in Figure 3 or 4 and have not been dealt with in the description hereinbefore. These are, however, of subordinate importance for the invention and may be of a kind known per se, for which reason it should not be necessary to describe them here. The error-correcting code, channel encoders channel decoders, speech encoders and speech decoders may also be of types known per se, and thus it is unnecessary to describe them here. The distribution of frames within the super frames and the radio traffic channels on the base stations may take place according to principles known per se, and are therefore not described here. Against the background of what is known per se in connection with synchronization, and not least from what is known from the given references, it would not appear necessary here to further describe details in the synchronization of the time references. Against the background of what is known within the field of mobile telephony, neither would it appear necessary to describe a protocol in the establishment of communication between the base stations and mobile stations or remaining signalling between them.

A method and equipment in accordance with the invention does not need to agree in all details with what has been described in connection with figures 1-5. For example, a 7, 12 or 21 cellular plan can be used instead of a 9 cellular plane.

Certain mobile stations can also be intended solely for transmission of digital information and therefore lack microphone, speech encoder and speech decoder. A base station can have more than two

transmitters for radio traffic channels and have more than two channel encoders and two channel decoders when more than two radio traffic channels are used by the base stations.

5

Claims

1. Method of synchronizing and transmitting information in a telecommunication network with fixed base stations (BS1, BS2,...) and movable mobile stations (MS1, MS2,...), information being transferred between base stations and mobile stations on a plurality of radio traffic channels (CH1, CH2, ...), the base stations being arranged in a cellular system and depending on the cellular system are allocated a frame (F1, F2,...) with time slots (TS0, TS1,...) within a super frame on a radio control channel, call and control signals being sent on the radio control channel from each base station to the mobile stations in the base station frame at predetermined times in relation to an internal time reference in the base station, said call and control signals being provided with identification information giving the identity of the transmitting base station, the base stations receiving call and control signals sent from the other base stations on the radio control channel, possible time differences between the internal time references of the base stations being determined at the base stations with the aid of the received call and control signals, such that the determined time differences are utilized at the base stations for adjusting their internal time references, characterized in that the transmission of information between base stations and mobile stations on the radio traffic channels takes place in time multiplex, each of the mobile stations being allocated a sequence of time slots on a radio traffic channel, in that any analogue information which is to be transferred on the radio traffic channels is digitalized before transmission in that information which is to be transmitted between a base station and a mobile station on a radio traffic channel is encoded with error-correcting coding before transmission, said coding extending over three or more time slots allocated to the mobile station on the radio traffic channel, and in that if the transmission on the radio traffic channels from a base station interferes too greatly with the reception at the base station of call and control signals from other base station, the transmission is intermittently interrupted for a time which is at least equally as long as a time slot and at most equally as long as a frame on a radio traffic channel.
2. Method as claimed in claim 1, characterized in that where there are time slots when no information is to be sent on any radio traffic channel from a base station, the reception at this base station, of call and control signals from other base stations on the radio control channel takes place during these time slots

when no information is to be transmitted, and in that call and control signals received during these time slots when no information is to be transmitted are primarily used for determining time differences at the base station, whereby the need of interrupting the transmission on the radio traffic channels is reduced or eliminated at the base station.

3. Method as claimed in claim 2, characterized in that the mobile stations associated with a base station are as far as possible allocated time slots on the radio traffic channels such that no information shall be transmitted on any such channel from the base station in certain time slots.

4. Method as claimed in any one of the preceding claims, characterized in that the transmission on the radio traffic channels from a base station are interrupted either during at most one of the frames in any super frame on the radio control channel or such that no time slot is interrupted more than twice in the same super frame, in order not to interfere too greatly with the reception at the base station of call and control signals.

5. Equipment for synchronizing and transmitting information in a radio communication network, said network including base stations (BS1, BS2,...) and mobile stations (MS1, MS2) adapted for transmission between them of information on a plurality of radio traffic channels (CH1, CH2,...), said base stations being organized in a cellular system and, depending on the cellular system, share a radio control channel in time multiplex so that each base station disposes over a frame (F1, F2,...) with time slots within a super frame on the radio control channel, said base stations including means (31, 35) for sending to the mobile stations call and control signals on the radio control channel in their frames at predetermined times in relation to their respective internal time references, said call and control signals including identification information giving the identity of the transmitting base stations, said equipment including

- a) reception means (32, 37) at the base stations for receiving call and control signals sent from the other base stations on the radio control channel,
- b) time difference measurement means (38) at the base stations for determining with the aid of the received call and control signals possible time differences between the internal time references of the base stations, and
- c) regulation means (40) at the base stations for adjusting the internal time references of the base stations with the aid of possible determined time differences,

the equipment being characterized by time multiplex means (36) at the base stations for transmitting information between the base stations and mobile stations in time multiplex on the radio traffic channels, said multiplex means being adapted such that on transmission they allocate each of

the mobile stations a succession of time slots on a radio traffic channel, by digitalizing means (11) at the mobile stations for digitalizing analogue information which is to be transmitted on the radio traffic channels, by encoding means (12, 45, 46) at the base stations and mobile stations for encoding information which is to be transferred between a base station and a mobile station on a radio traffic channel using an error-correction code extending over two or more successive time slots of the mobile station on the radio traffic channel, by transmission interruption means at the base stations for intermittently interrupting the transmission on the radio traffic channels from a base station if the transmission on such channels interferes too greatly with the reception at the same base station of call and control signals from other base stations, and in that the transmission interruption means are adapted, where appropriate, to intermittently interrupt the transmission during a time which is at least equally as long as a time slot and at most equally as long as a frame on a radio traffic channel.

6. Equipment as claimed in claim 5, characterized in that the reception means are adapted, where time slots are present when no information is to be sent on any radio traffic channel from a base station, to receive call and control signals from other base stations during these time slots when no information is to be transmitted, and in that the time difference measurement means are adapted to use primarily call and control signals received during these time slots for determining possible time differences.

7. Equipment as claimed in claim 6, characterized in that the time multiplex means at a base station allocates time slots on the radio traffic channels to the mobile stations as far as possible such that no information will be transmitted on any radio traffic channel from the base station in certain time slots.

8. Equipment as claimed in any one of claims 5-7, characterized in that the transmission interruption means interrupt, in appropriate cases, the transmission on the radio traffic channels from a base station, either during at most one of the frames in a super frame on the radio control channel or so that no time slot is interrupted more than twice in the same super frame.

50 Patentansprüche

1. Verfahren zum Synchronisieren und Senden von Informationen in einem Telekommunikationsnetz mit festen Basisstationen (BS1, BS2,...) und beweglichen Mobilstationen (MS1, MS2,...), wobei die Information zwischen Basisstationen und Mobilstationen über eine Vielzahl von Funkverkehrskanälen (CH1, CH2,...) gesendet wird ; die Basisstationen in einem

Zellsystem angeordnet sind, wobei ihnen in Abhängigkeit vom Zellsystem auf einem Funksteuerkanal innerhalb eines Superrahmens ein Rahmen (F1, F2,...) mit Zeitschlitten (TS0, TS1,...) zugewiesen ist; wobei über den Funksteuerkanal Ruf- und Steuersignale von jeder Basisstation zu den Mobilstationen innerhalb des Basisstationsrahmens zu vorbestimmten Zeiten relativ zu einer internen Zeitreferenz in der Basisstation gesendet werden; die Ruf- und Steuersignale mit Identifikationsinformationen über die Identität der sendenden Basisstation versehen sind; wobei die Basisstationen die von anderen Basisstationen gesendeten Ruf- und Steuersignale über den Funksteuerkanal empfangen; mögliche Zeitdifferenzen zwischen den internen Zeitreferenzen der Basisstationen in den Basisstationen mit Hilfe der empfangenen Ruf- und Steuersignale bestimmt werden, derart, daß die bestimmten Zeitdifferenzen in den Basisstationen zur Abstimmung ihrer internen Zeitreferenzen benutzt werden, dadurch gekennzeichnet, daß die Übertragung von Informationen zwischen Basisstationen und Mobilstationen über die Funkverkehrskanäle im Zeitmultiplex stattfindet, wobei jeder Mobilstation auf einem Funkverkehrskanal eine Folge von Zeitschlitten zugewiesen ist; daß jede über die Funkverkehrskanäle zu sendende analoge Information vor der Übertragung digitalisiert wird; daß Informationen, die über einen Funkverkehrskanal zwischen einer Basisstation und einer Mobilstation gesendet werden sollen, vor der Übertragung mittel Fehlerkodierung verschlüsselt werden, wobei sich die Kodierung über drei oder mehr den Mobilstationen auf dem Funkverkehrskanal zugewiesenen Zeitschlitten erstreckt; und daß im Falle, daß die Übertragung seltens einer Basisstation über die Funkverkehrskanäle in der Basisstation zu sehr mit dem Empfang von Ruf- und Steuersignalen einer anderen Basisstation interferiert, die Übertragung intermittierend während einer Zeitspanne unterbrochen wird, die mindestens ebenso lang wie ein Zeitschlitz und höchstens ebenso lang wie ein Rahmen auf einem Funkverkehrskanal ist.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß bei vorhandenen Zeitschlitten im Falle, daß von einer Basisstation keine Information über irgendeinen Funkverkehrskanal gesendet wird, in dieser Basisstation der Empfang von Ruf- und Steuersignalen über den Funksteuerkanal während dieser Zeitschlitte erfolgt, wenn keine Information übertragen wird; und daß die Ruf- und Steuersignale, die während dieser Zeitschlitte empfangen werden, wenn keine Information übertragen werden muß, in erster Linie zur Ermittlung von Zeitdifferenzen in der Basisstation benutzt werden, wodurch in der Basisstation die Notwendigkeit zur Unterbrechung der Übertragung auf den Funkverkehrskanälen reduziert oder eliminiert wird.

3. Verfahren nach Anspruch 2, dadurch gekenn-

zeichnet, daß den mit einer Basisstation verbundenen Mobilstationen so weit wie möglich Zeitschlitte auf den Funkverkehrskanälen in der Weise zugewiesen werden, daß in bestimmten Zeitschlitten von der Basisstation keine Information über irgendeinen dieser Kanäle gesendet wird.

4. Verfahren nach einem beliebigen vorhergehenden Anspruch, dadurch gekennzeichnet, daß die Sendung einer Basisstation über die Funkverkehrskanäle entweder während der Dauer von höchstens einer der Rahmen in einem beliebigen Superrahmen des Funkverkehrskanals unterbrochen wird, oder aber derart, daß kein Zeitschlitz öfter als zweimal im gleichen Superrahmen unterbrochen wird, um den Empfang von Ruf-Steuersignalen in der Basisstation nicht zu sehr zu stören.

5. Ausrüstung zum Synchronisieren und Senden von Informationen in einem Funkverkehrsnetz, wobei das Netz Basisstationen (BS1, BS2,...) und Mobilstationen (MS1, MS2) aufweist, die für die Übertragung von Informationen untereinander über eine Vielzahl von Funkverkehrskanälen (CH1, CH2,...) ausgelegt sind; wobei die Basisstationen in einem Zellsystem angeordnet sind und, in Abhängigkeit vom Zellsystem, sich im Zeitmultiplex einen Funkverkehrskanal teilen, so daß jede Basisstation über einen Rahmen (F1, F2,...) mit Zeitschlitten innerhalb eines Superrahmens des Funksteuerkanals verfügt; wobei die Basisstationen Mittel (31, 35) zum Senden von Ruf- und Steuersignalen über den Funksteuerkanal an die Mobilstationen in ihren Rahmen, in vorbestimmten Zeiten relativ zu ihren jeweiligen internen Zeitreferenzen, aufweisen; wobei die Ruf- und Steuersignale Identifikationsinformationen über die Identität der sendenden Basisstationen umfassen; und die genannte Ausrüstung folgende Mittel aufweist:

a) Empfangsmittel (32, 37) in den Basisstationen zum Empfangen der von den anderen Basisstationen über den Funksteuerkanal gesendeten Ruf- und Steuersignale;

b) Zeitdifferenzmeßmittel (38) in den Basisstationen zum Bestimmen möglicher Zeitdifferenzen zwischen den internen Zeitreferenzen der Basisstationen mit Hilfe der empfangenen Ruf- und Steuersignale; und

c) Regelungsmittel (40) in den Basisstationen zum Abstimmen der internen Zeitreferenzen der Basisstationen mit Hilfe von möglichen, festgesetzten Zeitdifferenzen;

wobei die Ausrüstung gekennzeichnet ist durch Zeitmultiplexmittel (36) in den Basisstationen zum Übertragen von Informationen zwischen den Basisstationen und den Mobilstationen im Zeitmultiplex über die Funkverkehrskanäle, und die Multiplexmittel so ausgelegt sind, daß sie beim Senden jeder Mobilstation eine Folge von Zeitschlitten auf einem Funkverkehrskanal zuweisen.

sen ; durch Digitalisiermittel 811) in den Mobilstationen zum Digitalisieren analoger Informationen, die über die Funkverkehrskanäle übertragen werden müssen ; durch Kodiernetz (12, 45, 46) in den Basisstationen und in den Mobilstationen zum Verschlüsseln von Informationen, die zwischen einer Basisstation und einer Mobilstation auf einem Funkverkehrskanal übertragen werden müssen, unter Verwendung eines Fehlerkorrekturkodes, der sich über zwei oder mehrere aufeinanderfolgende Zeitschlüsse der Mobilstation auf dem Funkverkehrskanal erstreckt ; durch Sendeunterbrechungsmittel in den Basisstationen zum intermittierenden Unterbrechen der Übertragung von einer Basisstation auf den Funkverkehrskanälen, falls die Übertragung auf diesen Kanälen in der betreffenden Basisstation zu sehr mit dem Empfang der Ruf- und Steuersignale anderer Basisstationen interferiert ; und daß die Sendeunterbrechungsmittel, wo zweckmäßig, so ausgelegt sind, daß sie die Übertragung intermittierend während einer Zeitdauer unterbrechen, die mindestens ebenso lang wie ein Zeitschlitz oder höchstens ebenso lang wie ein Rahmen eines Funkverkehrskanals ist.

6. Ausrüstung nach Anspruch 5, dadurch gekennzeichnet, daß die Empfangsmittel bei vorhandenen Zeitschlüßen im Falle, daß keine Information auf irgendeinem Funkverkehrskanal von einer Basisstation gesendet werden muß, für den Empfang von Ruf- und Steuersignalen anderer Basisstationen während dieser Zeitschlüsse ausgelegt sind, wenn keine Informationen übertragen werden müssen ; und daß die Zeitdifferenzmeßmittel so ausgelegt sind, daß sie zur Bestimmung möglicher Zeitdifferenzen in erster Linie Ruf- und Steuersignale verwenden, die während dieser Zeitschlüsse empfangen werden.

7. Ausrüstung nach Anspruch 6, dadurch gekennzeichnet, daß die Zeitmultiplexmittel in einer Basisstation Zeitschlüsse auf den Funkverkehrskanälen den Mobilstationen so weit wie möglich derart zuweisen, daß in bestimmten Zeitschlüßen von der Basisstation keine Information auf irgendeinem Funkverkehrskanal gesendet wird.

8. Ausrüstung nach einem beliebigen der Ansprüche 5 bis 7, dadurch gekennzeichnet, daß die Sendeunterbrechungsmittel in geeigneten Fällen die Sendung einer Basisstation auf den Funkverkehrskanälen entweder während höchstens eines Rahmens in einem Superrahmen des Funksteuerkanals unterbrechen, oder aber derart, daß kein Zeitschlitz öfter als zweimal im gleichen Superrahmen unterbrochen wird.

Revendications

1. Procédé de synchronisation et de transmission

d'information dans un réseau de télécommunication comportant des stations de base fixes (BS1, BS2,...) et des stations mobiles (MS1, MS2,...) pouvant se déplacer, dans lequel de l'information est transmise entre des stations de base et des stations mobiles sur un ensemble de canaux de trafic de radiocommunication (CH1, CH2,...), les stations de base étant organisées en un système cellulaire, dans une configuration dans laquelle, sous la dépendance du système cellulaire, une trame (F1, F2,...) avec des créneaux temporés (TS0, TS1,...) dans une super-trame, sur un canal de commande de radiocommunication, est attribuée à chaque station de base, des signaux d'appel et de commande étant émis sur le canal de commande de radiocommunication, à partir de chaque station de base vers les stations mobiles, dans la trame de la station de base, à des instants pré-déterminés en relation avec une référence de temps interne dans la station de base, ces signaux d'appel et de commande comprenant une information d'identification qui donne l'identité de la station de base émettrice, les stations de base recevant des signaux d'appel et de commande qui sont émis par les autres stations de base sur le canal de commande de radiocommunication, des différences de temps éventuelles entre les références de temps internes des stations de base étant déterminées aux stations de base à l'aide des signaux d'appel et de commande qui sont reçus, de façon que les différences de temps qui sont déterminées soient utilisées aux stations de base pour régler leurs références de temps internes, caractérisé en ce que la transmission d'information entre des stations de base et des stations mobiles sur les canaux de trafic de radiocommunication s'effectue en multiplex temporel, une séquence de créneaux temporés sur un canal de trafic de radiocommunication étant attribuée à chacune des stations mobiles, en ce qu'une information analogique éventuelle qui doit être transférée sur les canaux de trafic de radiocommunication est numérisée avant d'être émise, en ce qu'une information qui doit être émise entre une station de base et une station mobile sur un canal de trafic de radiocommunication est codée avec un code correcteur d'erreurs avant l'émission, ce codage s'étendant sur au moins trois créneaux temporés attribués à la station mobile sur le canal de trafic de radiocommunication, et en ce que si l'émission sur les canaux de trafic de radiocommunication, à partir d'une station de base, perturbe trop fortement la réception à la station de base de signaux d'appel et de commande provenant d'une autre station de base, l'émission est interrompue de façon intermittente pendant une durée qui est au moins égale à un créneau temporel et qui est au plus égale à une trame sur un canal de trafic de radiocommunication.

2. Procédé selon la revendication 1, caractérisé en ce que dans le cas où il existe des créneaux temporés pendant lesquels aucune information ne doit

être émise sur un canal de trafic de radiocommunication quelconque à partir d'une station de base, la réception à cette station de base de signaux d'appel et de commande provenant d'autres stations de base sur le canal de commande de radiocommunication s'effectue pendant ces créneaux temporels au cours desquels aucune information ne doit être émise, et en ce que des signaux d'appel et de commande qui sont reçus pendant les créneaux temporels au cours desquels aucune information ne doit être émise sont utilisés essentiellement pour déterminer des différences de temps à la station de base, grâce à quoi la nécessité d'interrompre l'émission sur les canaux de trafic de radiocommunication à la station de base est réduite ou éliminée.

3. Procédé selon la revendication 2, caractérisé en ce que les stations mobiles qui sont associées à une station de base ont, dans la mesure du possible, des créneaux temporels attribués sur les canaux de trafic de radiocommunication, qui sont choisis de façon qu'aucune information ne doive être émise sur un tel canal, à partir de la station de base, au cours de certains créneaux temporels.

4. Procédé selon l'une quelconque des revendications précédentes, caractérisé en ce que l'émission sur les canaux de trafic de radiocommunication, à partir d'une station de base, est interrompue soit pendant au plus l'une des trames d'une super-trame quelconque sur le canal de commande de radiocommunication, soit de façon qu'aucun créneau temporel ne soit interrompu plus de deux fois dans la même super-trame, pour ne pas perturber trop fortement la réception de signaux d'appel et de commande à la station de base.

5. Équipement pour la synchronisation et la transmission d'information dans un réseau de radiocommunication, ce réseau comprenant des stations de base (BS1, BS2,...) et des stations mobiles (MS1, MS2,...) qui sont conçues pour transmettre entre elles de l'information sur un ensemble de canaux de trafic de radiocommunication (CH1, CH2,...), les stations de base étant organisées en un système cellulaire et se partageant l'utilisation d'un canal de commande de radiocommunication en multiplex temporel, sous la dépendance du système cellulaire, de façon que chaque station de base dispose d'une trame (F1, F2,...), avec des créneaux temporels, dans une super-trame sur le canal de commande de radiocommunication, les stations de base comprenant des moyens (31, 35) destinés à émettre vers les stations mobiles des signaux d'appel et de commande sur le canal de commande de radiocommunication, dans leurs trames, à des instants prédéterminés en relation avec leurs références de temps internes respectives, ces signaux d'appel et de commande contenant une information d'identification qui donne l'identité des stations de base émettrices, cet équipement comprenant :

5 a) des moyens de réception (32, 37) aux stations de base, qui sont destinés à recevoir des signaux d'appel et de commande qui sont émis par les autres stations de base sur le canal de commande de radiocommunication,

10 b) des moyens de mesure de différence de temps (38), aux stations de base, pour déterminer avec l'aide des signaux d'appel et de commande reçus, des différences de temps possibles entre les références de temps internes des stations de base, et

15 c) des moyens de régulation (40), aux stations de base, pour régler les références de temps internes des stations de base, avec l'aide de différences de temps éventuelles qui ont été déterminées,

20 l'équipement étant caractérisé par des moyens de multiplexage temporel (36), aux stations de base, qui sont destinés à transmettre de l'information entre les stations de base et les stations mobiles, en multiplex temporel, sur les canaux de trafic de radiocommunication, ces moyens de multiplexage étant conçus de façon à attribuer à chacune des stations mobiles, au moment de l'émission, une succession de créneaux temporels sur un canal de trafic de radiocommunication, par des moyens de numérisation (11), aux stations mobiles, qui sont destinés à numériser une information analogique qui doit être émise sur les canaux de trafic de radiocommunication, par des moyens de codage (12, 45, 46), aux stations de base et aux stations mobiles, qui sont destinés à coder l'information qui doit être transmise entre une station de base et une station mobile sur un canal de trafic de radiocommunication, en utilisant un code correcteur d'erreurs qui s'étend sur au moins deux créneaux temporels successifs de la station mobile, sur le canal de trafic de radiocommunication, par des moyens d'interruption d'émission, aux stations de base, qui sont destinés à interrompre par intermittence l'émission sur les canaux de trafic de radiocommunication, à partir d'une station de base, si l'émission sur de tels canaux perturbe trop fortement la réception à la même station de base de signaux d'appel et de commande provenant d'autres stations de base, et en ce que les moyens d'interruption d'émission sont conçus de façon à interrompre l'émission par intermittence, lorsque c'est approprié, pendant une durée qui est au moins égale à un créneau temporel et qui est au plus égale à une trame, sur un canal de trafic de radiocommunication.

25 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995 1000 1005 1010 1015 1020 1025 1030 1035 1040 1045 1050 1055 1060 1065 1070 1075 1080 1085 1090 1095 1100 1105 1110 1115 1120 1125 1130 1135 1140 1145 1150 1155 1160 1165 1170 1175 1180 1185 1190 1195 1200 1205 1210 1215 1220 1225 1230 1235 1240 1245 1250 1255 1260 1265 1270 1275 1280 1285 1290 1295 1300 1305 1310 1315 1320 1325 1330 1335 1340 1345 1350 1355 1360 1365 1370 1375 1380 1385 1390 1395 1400 1405 1410 1415 1420 1425 1430 1435 1440 1445 1450 1455 1460 1465 1470 1475 1480 1485 1490 1495 1500 1505 1510 1515 1520 1525 1530 1535 1540 1545 1550 1555 1560 1565 1570 1575 1580 1585 1590 1595 1600 1605 1610 1615 1620 1625 1630 1635 1640 1645 1650 1655 1660 1665 1670 1675 1680 1685 1690 1695 1700 1705 1710 1715 1720 1725 1730 1735 1740 1745 1750 1755 1760 1765 1770 1775 1780 1785 1790 1795 1800 1805 1810 1815 1820 1825 1830 1835 1840 1845 1850 1855 1860 1865 1870 1875 1880 1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070 2075 2080 2085 2090 2095 2100 2105 2110 2115 2120 2125 2130 2135 2140 2145 2150 2155 2160 2165 2170 2175 2180 2185 2190 2195 2200 2205 2210 2215 2220 2225 2230 2235 2240 2245 2250 2255 2260 2265 2270 2275 2280 2285 2290 2295 2300 2305 2310 2315 2320 2325 2330 2335 2340 2345 2350 2355 2360 2365 2370 2375 2380 2385 2390 2395 2400 2405 2410 2415 2420 2425 2430 2435 2440 2445 2450 2455 2460 2465 2470 2475 2480 2485 2490 2495 2500 2505 2510 2515 2520 2525 2530 2535 2540 2545 2550 2555 2560 2565 2570 2575 2580 2585 2590 2595 2600 2605 2610 2615 2620 2625 2630 2635 2640 2645 2650 2655 2660 2665 2670 2675 2680 2685 2690 2695 2700 2705 2710 2715 2720 2725 2730 2735 2740 2745 2750 2755 2760 2765 2770 2775 2780 2785 2790 2795 2800 2805 2810 2815 2820 2825 2830 2835 2840 2845 2850 2855 2860 2865 2870 2875 2880 2885 2890 2895 2900 2905 2910 2915 2920 2925 2930 2935 2940 2945 2950 2955 2960 2965 2970 2975 2980 2985 2990 2995 3000 3005 3010 3015 3020 3025 3030 3035 3040 3045 3050 3055 3060 3065 3070 3075 3080 3085 3090 3095 3100 3105 3110 3115 3120 3125 3130 3135 3140 3145 3150 3155 3160 3165 3170 3175 3180 3185 3190 3195 3200 3205 3210 3215 3220 3225 3230 3235 3240 3245 3250 3255 3260 3265 3270 3275 3280 3285 3290 3295 3300 3305 3310 3315 3320 3325 3330 3335 3340 3345 3350 3355 3360 3365 3370 3375 3380 3385 3390 3395 3400 3405 3410 3415 3420 3425 3430 3435 3440 3445 3450 3455 3460 3465 3470 3475 3480 3485 3490 3495 3500 3505 3510 3515 3520 3525 3530 3535 3540 3545 3550 3555 3560 3565 3570 3575 3580 3585 3590 3595 3600 3605 3610 3615 3620 3625 3630 3635 3640 3645 3650 3655 3660 3665 3670 3675 3680 3685 3690 3695 3700 3705 3710 3715 3720 3725 3730 3735 3740 3745 3750 3755 3760 3765 3770 3775 3780 3785 3790 3795 3800 3805 3810 3815 3820 3825 3830 3835 3840 3845 3850 3855 3860 3865 3870 3875 3880 3885 3890 3895 3900 3905 3910 3915 3920 3925 3930 3935 3940 3945 3950 3955 3960 3965 3970 3975 3980 3985 3990 3995 4000 4005 4010 4015 4020 4025 4030 4035 4040 4045 4050 4055 4060 4065 4070 4075 4080 4085 4090 4095 4100 4105 4110 4115 4120 4125 4130 4135 4140 4145 4150 4155 4160 4165 4170 4175 4180 4185 4190 4195 4200 4205 4210 4215 4220 4225 4230 4235 4240 4245 4250 4255 4260 4265 4270 4275 4280 4285 4290 4295 4300 4305 4310 4315 4320 4325 4330 4335 4340 4345 4350 4355 4360 4365 4370 4375 4380 4385 4390 4395 4400 4405 4410 4415 4420 4425 4430 4435 4440 4445 4450 4455 4460 4465 4470 4475 4480 4485 4490 4495 4500 4505 4510 4515 4520 4525 4530 4535 4540 4545 4550 4555 4560 4565 4570 4575 4580 4585 4590 4595 4600 4605 4610 4615 4620 4625 4630 4635 4640 4645 4650 4655 4660 4665 4670 4675 4680 4685 4690 4695 4700 4705 4710 4715 4720 4725 4730 4735 4740 4745 4750 4755 4760 4765 4770 4775 4780 4785 4790 4795 4800 4805 4810 4815 4820 4825 4830 4835 4840 4845 4850 4855 4860 4865 4870 4875 4880 4885 4890 4895 4900 4905 4910 4915 4920 4925 4930 4935 4940 4945 4950 4955 4960 4965 4970 4975 4980 4985 4990 4995 5000 5005 5010 5015 5020 5025 5030 5035 5040 5045 5050 5055 5060 5065 5070 5075 5080 5085 5090 5095 5100 5105 5110 5115 5120 5125 5130 5135 5140 5145 5150 5155 5160 5165 5170 5175 5180 5185 5190 5195 5200 5205 5210 5215 5220 5225 5230 5235 5240 5245 5250 5255 5260 5265 5270 5275 5280 5285 5290 5295 5300 5305 5310 5315 5320 5325 5330 5335 5340 5345 5350 5355 5360 5365 5370 5375 5380 5385 5390 5395 5400 5405 5410 5415 5420 5425 5430 5435 5440 5445 5450 5455 5460 5465 5470 5475 5480 5485 5490 5495 5500 5505 5510 5515 5520 5525 5530 5535 5540 5545 5550 5555 5560 5565 5570 5575 5580 5585 5590 5595 5600 5605 5610 5615 5620 5625 5630 5635 5640 5645 5650 5655 5660 5665 5670 5675 5680 5685 5690 5695 5700 5705 5710 5715 5720 5725 5730 5735 5740 5745 5750 5755 5760 5765 5770 5775 5780 5785 5790 5795 5800 5805 5810 5815 5820 5825 5830 5835 5840 5845 5850 5855 5860 5865 5870 5875 5880 5885 5890 5895 5900 5905 5910 5915 5920 5925 5930 5935 5940 5945 5950 5955 5960 5965 5970 5975 5980 5985 5990 5995 6000 6005 6010 6015 6020 6025 6030 6035 6040 6045 6050 6055 6060 6065 6070 6075 6080 6085 6090 6095 6100 6105 6110 6115 6120 6125 6130 6135 6140 6145 6150 6155 6160 6165 6170 6175 6180 6185 6190 6195 6200 6205 6210 6215 6220 6225 6230 6235 6240 6245 6250 6255 6260 6265 6270 6275 6280 6285 6290 6295 6300 6305 6310 6315 6320 6325 6330 6335 6340 6345 6350 6355 6360 6365 6370 6375 6380 6385 6390 6395 6400 6405 6410 6415 6420 6425 6430 6435 6440 6445 6450 6455 6460 6465 6470 6475 6480 6485 6490 6495 6500 6505 6510 6515 6520 6525 6530 6535 6540 6545 6550 6555 6560 6565 6570 6575 6580 6585 6590 6595 6600 6605 6610 6615 6620 6625 6630 6635 6640 6645 6650 6655 6660 6665 6670 6675 6680 6685 6690 6695 6700 6705 6710 6715 6720 6725 6730 6735 6740 6745 6750 6755 6760 6765 6770 6775 6780 6785 6790 6795 6800 6805 6810 6815 6820 6825 6830 6835 6840 6845 6850 6855 6860 6865 6870 6875 6880 6885 6890 6895 6900 6905 6910 6915 6920 6925 6930 6935 6940 6945 6950 6955 6960 6965 6970 6975 6980 6985 6990 6995 7000 7005 7010 7015 7020 7025 7030 7035 7040 7045 7050 7055 7060 7065 7070 7075 7080 7085 7090 7095 7100 7105 7110 7115 7120 7125 7130 7135 7140 7145 7150 7155 7160 7165 7170 7175 7180 7185 7190 7195 7200 7205 7210 7215 7220 7225 7230 7235 7240 7245 7250 7255 7260 7265 7270 7275 7280 7285 7290 7295 7300 7305 7310 7315 7320 7325 7330 7335 7340 7345 7350 7355 7360 7365 7370 7375 7380 7385 7390 7395 7400 7405 7410 7415 7420 7425 7430 7435 7440 7445 7450 7455 7460 7465 7470 7475 7480 7485 7490 7495 7500 7505 7510 7515 7520 7525 7530 7535 7540 7545 7550 7555 7560 7565 7570 7575 7580 7585 7590 7595 7600 7605 7610 7615 7620 7625 7630 7635 7640 7645 7650 7655 7660 7665 7670 7675 7680 7685 7690 7695 7700 7705 7710 7715 7720 7725 7730 7735 7740 7745 7750 7755 7760 7765 7770 7775 7780 7785 7790 7795 7800 7805 7810 7815 7820 7825 7830 7835 7840 7845 7850 7855 7860 7865 7870 7875 7880 7885 7890 7895 7900 7905 7910 7915 7920 7925 7930 7935 7940 7945 7950 7955 7960 7965 7970 7975 7980 7985 7990 7995 8000 8005 8010 8015 8020 8025 8030 8035 8040 8045 8050 8055 8060 8065 8070 8075 8080 8085 8090 8095 8100 8105 8110 8115 8120 8125 8130 8135 8140 8145 8150 8155 8160 8165 8170 8175 8180 8185 8190 8195 8200 8205 8210 8215 8220 8225 8230 8235 8240 8245 8250 8255 8260 8265 8270 8275 8280 8285 8290 8295 8300 8305 8310 8315 8320 8325 8330 8335 8340 8345 8350 8355 8360 8365 8370 8375 8380 8385 8390 8395 8400 8405 8410 8415 8420 8425 8430 8435 8440 8445 8450 8455 8460 8465 8470 8475 8480 8485 8490 8495 8500 8505 8510 8515 8520 8525 8530 8535 8540 8545 8550 8555 8560 8565 8570 8575 8580 8585 8590 8595 8600 8605 8610 8615 8620 8625 8630 8635 8640 8645 8650 8655 8660 8665 8670 8675 8680 8685 8690 8695 8700 8705 8710 8715 8720 8725 8730 8735 8740 8745 8750 8755 8760 8765 8770 8775 8780 8785 8790 8795 8800 8805 8810 8815 8820 8825 8830 8835 8840 8845 8850 8855 8860 8865 8870 8875 8880 8885 8890 8895 8900 8905 8910 8915 8920 8925 8930 8935 8940 8945 8950 8955 8960 8965 8970 8975 8980 8985 8990 8995 9000 9005 9010 9015 9020 9025 9030 9035 9040 9045 9050 9055 9060 9065 9070 9075 9080 9085 9090 9095 9100 9105 9110 9115 9120 9125 9130 9135 9140 9145 9150 9155 9160 9165 9170 9175 9180 9185 9190 9195 9200 9205 9210 9215 9220 9225 9230 9235 9240 9245 9250 9255 9260 9265 9270 9275 9280 9285 9290 9295 9300 9305 9310 9315 9320 9325 9330 9335 9340 9345 9350 9355 9360 9365 9370 9375 9380 9385 9390 9395 9400 9405 9410 9415 9420 9425 9430 9435 9440 9445 9450 9455 9460 9465 9470 9475 9480 9485 9490 9495 9500 9505 9510 9515 9520 9525 9530 9535 9540 9545 9550 9555 9560 9565 9570 9575 9580 9585 9590 9595 9600 9605 9610 9615 9620 9625 9630 9635 9640 9645 9650 9655 9660 9665 9670 9675 9680 9685 9690 9695 9700 9705 9710 9715 9720 9725 9730 9735 9740 9745 9750 9755 9760 9765 9770 9775 9780 9785 9790 9

21

EP 0 286 614 B1

22

façon à recevoir des signaux d'appel et de commande provenant d'autres stations de base pendant ces créneaux temporels au cours desquels aucune information ne doit être émise, et en ce que les moyens de mesure de différence de temps sont conçus de façon à utiliser principalement des signaux d'appel et de commande qui sont reçus pendant ces créneaux temporels, pour déterminer des différences de temps éventuelles.

7. **Equipement selon la revendication 6, caractérisé en ce que les moyens de multiplexage temporel à une station de base attribuent des créneaux temporels sur les canaux de trafic de radiocommunication aux stations mobiles pour faire en sorte que, dans la mesure du possible, aucune information ne soit émise sur un canal de trafic de radiocommunication quelconque, à partir de la station de base, dans certains créneaux temporels.**

8. **Equipement selon l'une quelconque des revendications 5-7, caractérisé en ce que les moyens d'interruption d'émission interrompent, dans des cas appropriés, l'émission sur les canaux de trafic de radiocommunication à partir d'une station de base, soit pendant l'une au plus des trames dans une supertrame sur le canal de commande de radiocommunication, soit de façon qu'aucun créneau temporel ne soit interrompu plus de deux fois dans la même supertrame.**

5

10

15

20

25

30

35

40

45

50

55

12

EP 0 286 614 B1

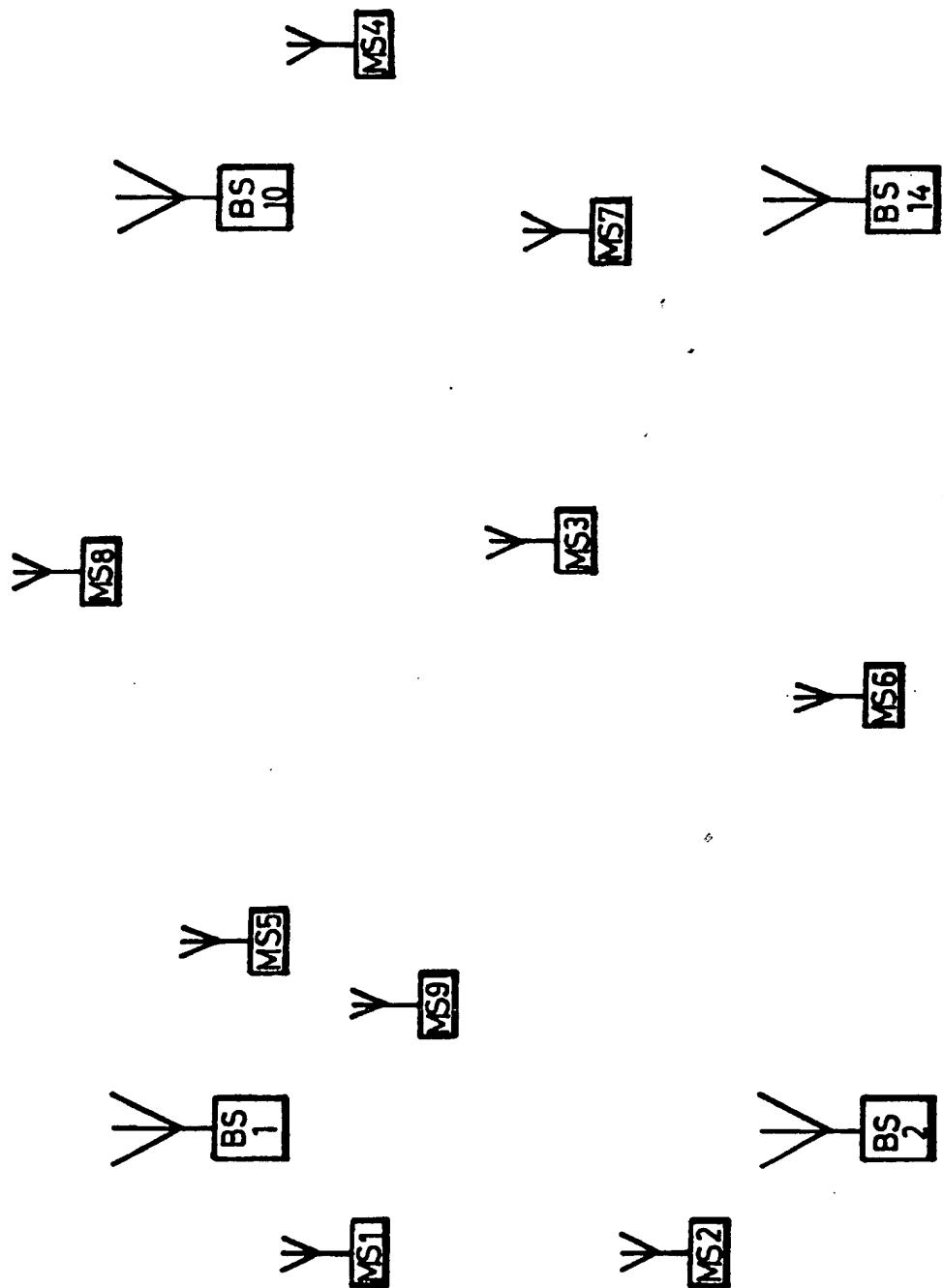


Fig.1

EP 0 286 614 B1

| | | | | | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| CH1 | MS |
| TS0 | TS1 | TS2 | TS3 | TS4 | TS5 | TS6 | TS7 | TS0 | TS1 | TS2 | TS3 | TS4 | TS5 | TS6 | TS7 | TS0 | TS1 | TS2 | TS3 | TS4 | TS5 |

| | | | | | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| CH2 | MS |
| TS0 | TS1 | TS2 | TS3 | TS4 | TS5 | TS6 | TS7 | TS0 | TS1 | TS2 | TS3 | TS4 | TS5 | TS6 | TS7 | TS0 | TS1 | TS2 | TS3 | TS4 | TS5 |

Fig.2

| | | | | | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| F1 | BS1 | BS2 | BS3 | | | | | | | | | | | | | | | | | | |
| TS0 | TS1 | TS2 | TS3 | TS4 | TS5 | TS6 | TS7 | TS0 | TS1 | TS2 | TS3 | TS4 | TS5 | TS6 | TS7 | TS0 | TS1 | TS2 | TS3 | TS4 | TS5 |
| F4 | BS4 | BS5 | BS6 | | | | | | | | | | | | | | | | | | |
| F5 | | | | | | | | | | | | | | | | | | | | | |
| F7 | BS7 | BS8 | BS9 | | | | | | | | | | | | | | | | | | |
| F8 | | | | | | | | | | | | | | | | | | | | | |
| F9 | | | | | | | | | | | | | | | | | | | | | |

Fig.3

EP 0 286 614 B1

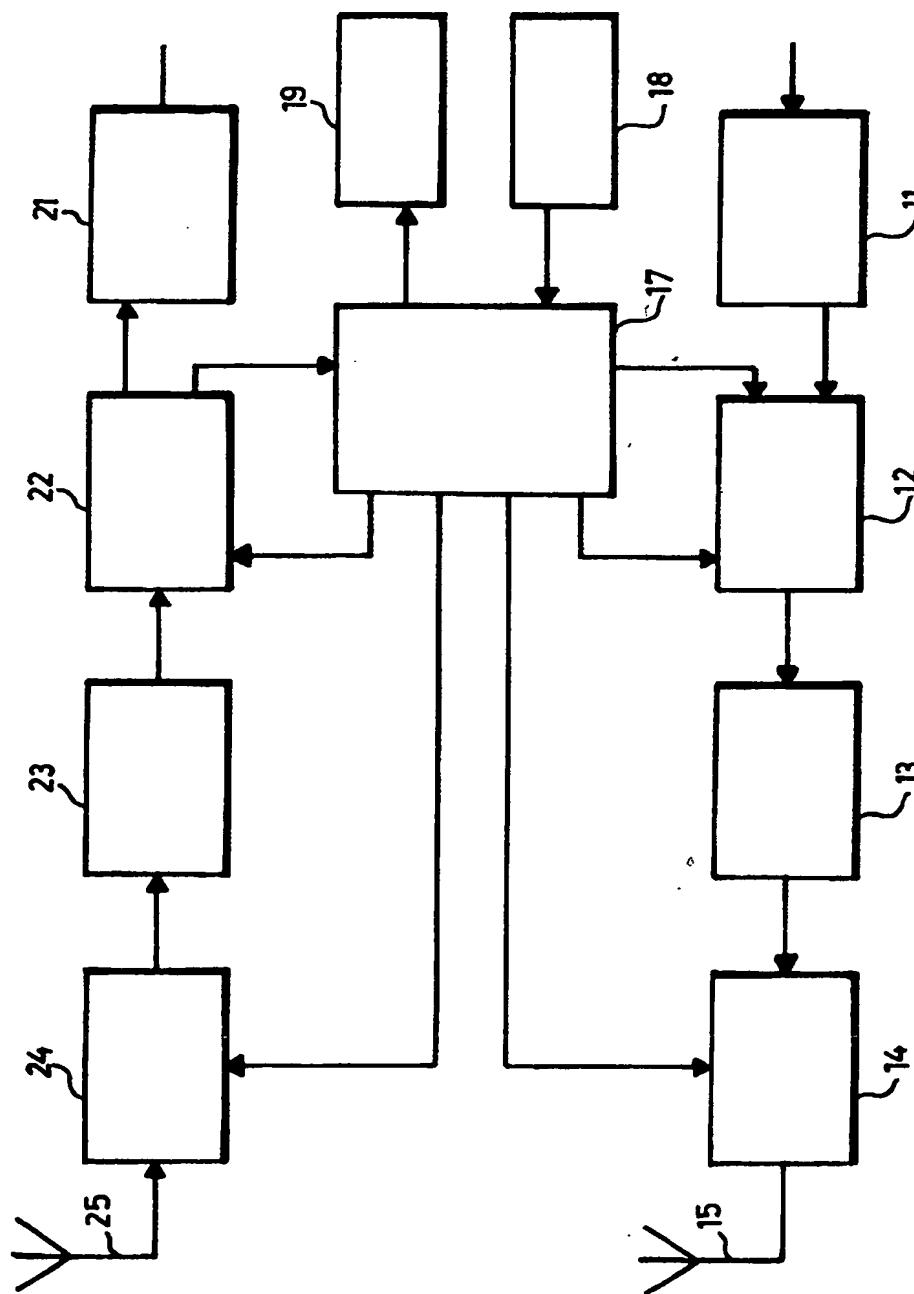


Fig.4

EP 0 286 614 B1

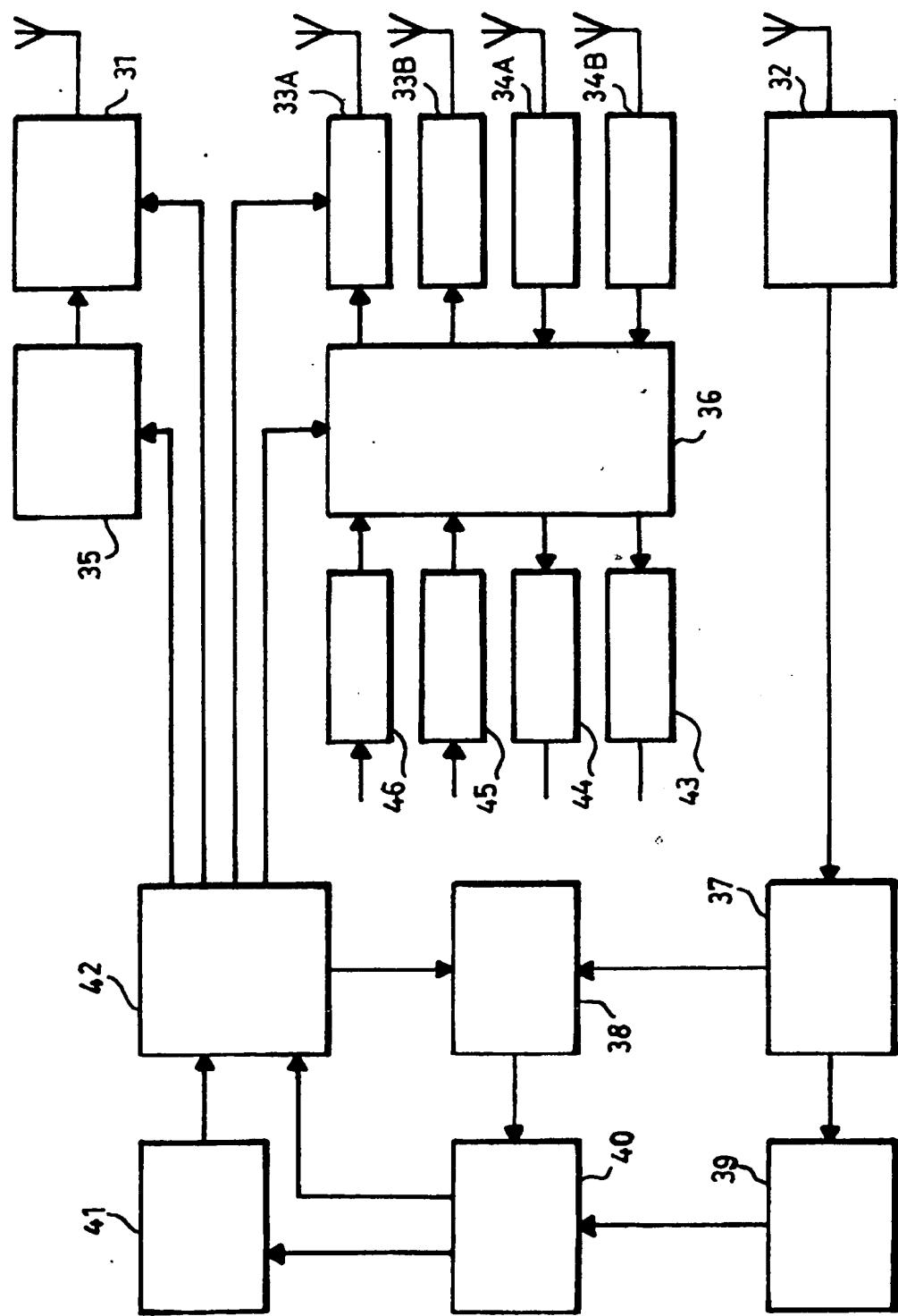


Fig.5